

CLAIMS

1. A modulation method of applying quadrature modulation to a first input symbol and a second input
5 symbol, comprising a step of applying quadrature modulation to a Nyquist signal of said first input symbol and a Nyquist signal of said second input symbol obtained by giving a delay difference corresponding to an integer multiple of $1/4$ of the symbol period of said input symbol
10 to the Nyquist signal of said first input symbol using a cosine wave having a frequency corresponding to an odd-number multiple of the basic frequency of each said Nyquist signal as a carrier.

15 2. The modulation method according to claim 1, comprising:

a setp of giving a delay difference corresponding to $1/4$ of the symbol period to each of four lines of input symbols and Nyquist-shaping the symbols to obtain first
20 to fourth Nyquist signals having a delay difference corresponding to $1/4$ of the symbol period;

a primary modulation step of carrying out quadrature modulation on first and second Nyquist signals having a delay difference corresponding to $2/4$ of the symbol
25 period and on third and fourth Nyquist signals having a delay difference corresponding to $2/4$ of the symbol period using a cosine wave having a frequency

corresponding to an odd-number multiple of the basic frequency of each said Nyquist signal as a carrier; and

a secondary modulation step of carrying out quadrature modulation on the signal resulting from quadrature modulation of said first and second Nyquist signals and the signal resulting from quadrature modulation of said third and fourth Nyquist signals obtained in said primary modulation step using a carrier of a predetermined frequency.

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3. The modulation method according to claim 1, comprising: a step of giving a delay difference corresponding to $1/4$ of the symbol period to each of four lines of input symbols and Nyquist-shaping the symbols to thereby obtain first to fourth Nyquist signals having a delay difference corresponding to $1/4$ of the symbol period;

a primary modulation step of carrying out quadrature modulation on the first and second Nyquist signals having a delay difference corresponding to $1/4$ of the symbol period and the third and fourth Nyquist signals having a delay difference corresponding to $1/4$ of the symbol period using a carrier having a predetermined frequency; and

a secondary modulation step of carrying out quadrature modulation on the signal resulting from quadrature modulation of said first and second Nyquist

signals and the signal resulting from quadrature modulation of said third and fourth Nyquist signals obtained in said primary modulation step using a cosine wave having a frequency corresponding to an odd-number multiple of the basic frequency of each said Nyquist signal
5 as a carrier.

4. A modulation apparatus comprising a quadrature modulator that inputs a first Nyquist signal of a first input symbol and a second Nyquist signal of a second input
10 symbol having a delay difference corresponding to an integer multiple of $1/4$ of the input symbol period with respect to the Nyquist signal of said first input symbol and carries out quadrature modulation on the first and
15 second Nyquist signals using a cosine wave having a frequency corresponding to an odd-number multiple of the basic frequency of each Nyquist signal.

5. The modulation apparatus according to claim 4,
20 comprising:

a group of delayers that give a delay difference corresponding to $1/4$ of the symbol period to each of four lines of input symbols;

Nyquist filters that form Nyquist signals from said
25 four lines of symbols;

first and second quadrature modulators that input Nyquist signals having a delay difference corresponding

to $2/4$ of the symbol period respectively and apply quadrature modulation to the input Nyquist signals using a cosine wave of a frequency corresponding to an odd-number multiple of the basic frequency of each said Nyquist signal
5 as a carrier; and

third quadrature modulator that carries out quadrature modulation using the modulated signal obtained from said first quadrature modulator and the modulated signal obtained from said second quadrature modulator
10 with a carrier having a predetermined frequency.

6. The modulation apparatus according to claim 4, comprising:

a group of delayers that give a delay difference
15 corresponding to $1/4$ of the symbol period to each of four lines of input symbols;

Nyquist filters that form Nyquist signals from said four lines of symbols;

first and second quadrature modulators that input
20 Nyquist signals having a delay difference corresponding to an odd-number multiple of $1/4$ of the symbol period respectively and apply quadrature modulation using a carrier of a predetermined frequency; and

a third quadrature modulator that carries out
25 quadrature modulation using the modulated signal obtained from said first quadrature modulator and the modulated signal obtained from said second quadrature modulator

with a cosine wave having a frequency corresponding to an odd-number multiple of the basic frequency of each said Nyquist signal as a carrier.

5 7. A modulation apparatus comprising:

 a group of delayers that give a delay difference corresponding to $1/4$ of the symbol period to each of four lines of input symbols;

 Nyquist filters that form Nyquist signals from said
10 four lines of symbols;

 first and second quadrature modulators that input Nyquist signals having a delay difference corresponding to an integer multiple of $1/4$ of the symbol period and output the input Nyquist signals at a frequency
15 corresponding to an odd-number multiple of the basic frequency of each said Nyquist signal alternately;
 and

 a third quadrature modulator that carries out quadrature modulation using the modulated signal obtained
20 from said first quadrature modulator and the modulated signal obtained from said second quadrature modulator with a carrier having a predetermined frequency.

8. A demodulation apparatus comprising a quadrature
25 demodulator that carries out quadrature demodulation on a modulated signal obtained by carrying out quadrature modulation on first and second Nyquist signals using a

cosine wave having a frequency corresponding to an odd-number multiple of the basic frequency of each said Nyquist signal.

5 9. The demodulation apparatus according to claim 8, comprising:

a first quadrature demodulator that receives a modulated signal and carries out quadrature demodulation on the modulated signal using a predetermined carrier
10 frequency to obtain first and second demodulated signals;

a second quadrature demodulator that carries out quadrature demodulation on said first demodulated signal using a cosine wave having a frequency corresponding to an odd-number multiple of the basic frequency of each
15 said Nyquist signal to obtain third and fourth demodulated signals; and

a third quadrature demodulator that carries out quadrature demodulation on said second demodulated signal using a cosine wave having a frequency corresponding to
20 an odd-number multiple of the basic frequency of each said Nyquist signal to obtain fifth and sixth demodulated signals.

10. The demodulation apparatus according to claim 8,
25 comprising:

a first quadrature demodulator that inputs a modulated signal and carries out quadrature demodulation

on the modulated signal using a cosine wave having a frequency corresponding to an odd-number multiple of the basic frequency of each said Nyquist signal to obtain first and second demodulated signals;

5 a second quadrature demodulator that carries out quadrature demodulation on said first demodulated signal using a predetermined carrier frequency to obtain third and fourth demodulated signals; and

 a third quadrature demodulator that carries out
10 quadrature demodulation on said second demodulated signal using a predetermined carrier frequency to obtain fifth and sixth demodulated signals.

11. A radio communication system comprising the
15 modulation apparatus according to claim 4 and the demodulation apparatus according to claim 8.

12. A radio communication system comprising the
modulation apparatus according to claim 5 and the
20 demodulation apparatus according to claim 9.

13. A radio communication system comprising the
modulation apparatus according to claim 6 and the
demodulation apparatus according to claim 10.